

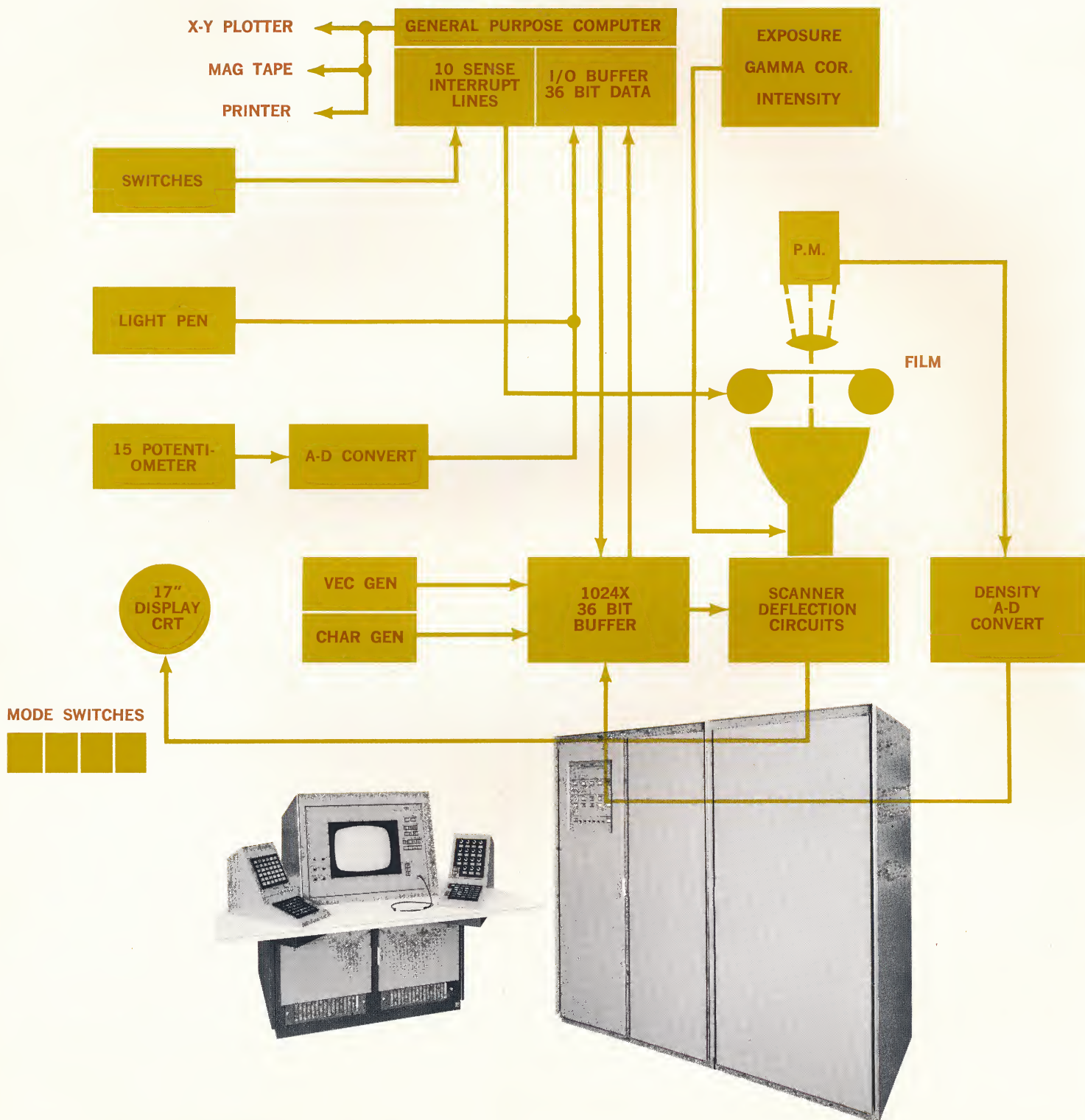
CRT / FILM Reader/Writer



WAVEFORM DISPLAY ANALYZER

General Precision, Inc., Link Group

*"and precision
film reader"*



"Development of large scale computing machinery has produced a trend towards centralization of corporate computational facilities. Operational considerations and administrative procedures have placed the engineer in a remote position from the computer. Experimental investigations and, in fact, almost all computations for developmental efforts, require several iterative cycles of data preparation, machine runs, and visual inspection of large volumes of tabulated printout, etc. Dynamic man-machine communication is difficult to achieve, and when possible, is based on relatively low overall information transfer rates.

"... It is evident that substantial reductions in machine time and engineering analysis time can be achieved by placing the problem originator in closer proximity to the computer, and by providing improved data handling and communication facilities. Such facilities would maximize information bandwidth and minimize transportation time through the run-analysis loop. A general purpose display, with film scanning and photographic output capability, and supported by appropriate "host computer" systems programming, has sufficient flexibility to meet such requirements for complex data conversion and entry, operator/analyst communication and control, and high volume output as a printer/plotter."¹

A functional solution to this problem was conceived by the Ballistic Systems Division of USAF and Aerospace Corporation, and is being designed and fabricated by the Link Group, General Precision, Inc.

¹ "A Data Communication Subsystem," Allan H. Gott, Aerospace Corp., Society for Information Display, February 1964.

The Waveform Display Analyzer is a computer input-output display device consisting of two units: a scanner, and a display unit. It combines man's decision-making capability, self-programming flexibility and inductive reasoning potential with the extremely fast read-write capability of a flying spot scanner system.

The Waveform Display Analyzer is used in analyzing and evaluating: Re-entry Phenomenon, Elint, ECM and ECCM, Wind Tunnel Data, Nuclear Radiation Patterns, Sonar and Oceanographic Returns, Propulsion Data, Upper Atmosphere Phenomenon, Weather Radar, Bore Site Data, Missing Data in a Transmission (Telemetry), Contour Information (Mosaics), Linear Accelerator Data, and Medical Information.

THE WAVEFORM DISPLAY ANALYZER WILL:

- ☐ Scan a film image or waveform in a predetermined pattern and digitize the scanned data;
- ☐ Display a waveform reconstructed from digital data;
- ☐ Display a dot representation of a film image or digitally reconstructed waveform, together with descriptive alpha-numerics and special symbols.
- ☐ Scan and digitize density information and provide the X and Y location of this information to the computer.
- ☐ Accept and identify operator commands (inserted at the console) and introduce them to the computer.
- ☐ Record computer outputs on film.
The resulting imagery may be black and white or tonal in composition.
- ☐ The machine itself can easily produce over 16 controlled light levels. The exact number of resulting density shades on the film is determined by film type and processing techniques.

Input to the Waveform Display Analyzer is in the form of spectrographic, densitometric and waveform data recorded on 16mm, 35mm, and 70mm film. The Waveform Display Analyzer will perform the initial scanning operation, digitize the resultant data, and store it in a 1024 word (36 bits per word) buffer. The operator may, after viewing the recorded data on a 17" CRT, or when the buffer is full, introduce the data into the host digital computer for subsequent processing and numerical analysis.

The Waveform Display Analyzer consists of an optical scanner cabinet (analyzer), and an operator's display/control console. Construction

of the optics and electronics conforms to that used successfully in previous Link precision scanners such as the Video Film Converter class of equipments used on the NASA Ranger and Surveyor Program, and the Satellite Analog and Digital Data Display System used on the Nimbus Weather Satellite System. The operator's console consists of a 17" display CRT, switch matrices, various mode switches, computer command switches, potentiometers, and a light pen. The Waveform Display Analyzer generates, by digital techniques, a 1024 x 1024 bit matrix when scanning a diapositive or negative film image. 512 x 512 and 2048 x 2048 matrixes are also available. A further feature allows smaller, selected areas, lines, or patterns to be scanned under computer control. The video from scanned areas is fed to the display CRT so that the recorded data is viewed simultaneously with its input to a host computer.

The Scanner includes a 36 bit word I/O buffer capable of storing 1024 words which permits communication with the host computer, display, and a series of peripheral devices.

The Scanner and Display units may be operated in tandem, or may provide a useful peripheral function independently. The Scanner is capable of extracting film-stored data of any kind, and feeding it in digital fashion to a computer. It is also capable of receiving digital output data and storing it on film at rates equal to or faster than presently acceptable on high speed magnetic tape units.

The Display can also operate as a separate input-output unit. It will display computer stored or generated data, or serve as a query or entry device for its operator.

Waveform Display Analyzer devices have been suggested as "a facility for three dimensional shape description." Graphic images of two or three dimensional descriptions can be displayed in addition to orthogonal and perspective views, and graphical and cartographic data. Other applications include photogrammetry, mapping, and command and control displays.

It has been said that the densest storage medium, with the widest bandwidth, can be bought at the corner drugstore . . . film. Increasing numbers of data processing centers are taking advantage of the input-output versatility of film—generating the requirement for an on-line Scanner. Some scanners are also capable of opaque reading—oscillographs, etc. With the Waveform Display Analyzer, it is now possible to read "A" scope photography, radar and video data, event tracks, and an unlimited number of other types of data.

SPECIFICATIONS

Console

Input:	Digital 36 bit word. System is readily adaptable to other word lengths.
Storage capacity:	1024 words, 36 bits in length. Process instructions are stored in lower portion of memory, digitized scan data in upper portion. Automatic overflow detection.
Data Interface:	IBM C-line drivers and terminators. May be readily adapted to other levels.
Buffer Storage Speed:	4 microseconds for Read/Restore or Clear/Write cycle.
Character Generator:	Typically will provide 63 characters or symbols. Generation speeds up to 100,000 characters per second. Three character sizes 128, 85 or 64 characters per line. Other character/symbol combinations and rates may be provided.
Line Generator:	$X_o, Y_o; X_o + \Delta_x; Y_o + \Delta_y$. 16,000 sequential vectors per second. Vectors may be of arbitrary lengths.
Digital Resolution:	1024 x 1024 grid. (512 x 512 and 2048 x 2048 may also be provided.)
Orientation:	Normal or 90° rotation.
CRT Display:	17" aluminized TV-type tube.
Status Indicators:	Indicator lights provide the operator with operating status information.
Circuitry:	All Solid state components (Except CRT).

OPTIONS

- Auto Entry Switches:** 64 keys, each capable of entering a 6-bit word to host computer either directly or through the core memory buffer. Labeled by a thin plastic overlay.
- Potentiometer Input:** 15 precision potentiometers whose outputs are digitized to 10 bits are provided for entering parametric data to host computer.
- Light Pen:** When placed against display CRT causes either the X Y coordinate of the activating vector or the core memory buffer address which contained the activating sweep to be extracted and held for host computer processing.

Scanner

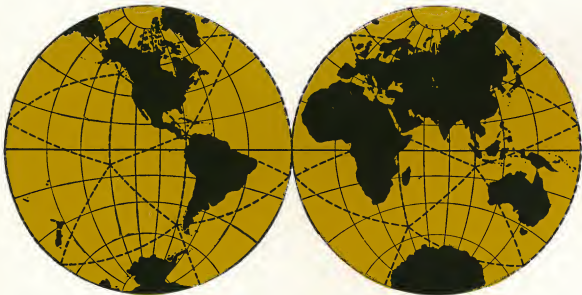
- Modes:** Scanner may be used to read or expose film. All operating modes automatically controlled by instructions from computer. When in read-out mode, computer controlled threshold value may be set to provide photo-multiplier noise filtering; only PM signals in excess of threshold value activate film conversion process. Capable of reading either positive or negative films. Output of PM modulates Z-axis on monitor CRT whose deflection system is driven from the same signal as the scanner.

DENSITOMETRIC SPECIFICATIONS

As supplied, the system can detect or record 16 grey scale levels. Other options are available depending upon scanning speed. Also, depending upon film selection and processing, a wide variety of density gammas are available.

POWER REQUIREMENTS

Basic Unit 208/120 volt, 3 phase, 4 wire, 2000 watts.



The Link Group of General Precision, Inc. is a world-wide organization with unique problem solving capabilities, proficient in the area of total systems support or any of its elements. For additional information concerning application of these capabilities to solution of your problems, contact:

**Advanced Products Sales
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**GP GENERAL
PRECISION INC.**

LINK GROUP



LINK GROUP

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SYSTEMS DIVISION

June 14, 1966

Mr. T. H. Nelson
Instructor
Vassar College
Poughkeepsie, New York 12601

Dear Mr. Nelson:

Thank you for your inquiry concerning the new Link Waveform Display-Analyzer. Construction of the first system has already been completed, and delivery has been made to the Ballistic Systems Division of the United States Air Force.

This device offers an operator the opportunity to utilize the latest techniques in dynamic man-machine communication to drastically reduce the cycle time for data preparation and correction. This feature alone, while indeed impressive, represents only a small part of the total system capability. Link's new Display-Analyzer also provides industry with the first machine capable of high precision film reading and recording with one flying spot CRT main frame. The unit is economically feasible where only one function is required; where a customer has need for the dual scanning and recording feature, the Link system is unbeatable.

We would like to emphasize that our firm possesses the technical depth necessary to alter this system to your specific requirements. The Analyzer can be interfaced with any computer or processing complex, and its own internal memory can be expanded for the more stringent time sharing problems.

The enclosed brochure should hopefully produce further interest. If any questions should develop or if more information is desired, please contact me at the Link Western Development Lab or our Advanced Products Sales Manager, Mr. Tom Harding, in Binghamton, New York.

Mr. T. T. Harding
LINK GROUP, GPI
Binghamton, New York
(607) 772-3135

Sincerely,

LINK GROUP, GENERAL PRECISION, INC.

A handwritten signature in dark ink, reading 'John H. Mellard'.

John H. Mellard
Western Area Manager
Advanced Products Sales

JHM:ld
Encl:WD/A